REVIEWS

Macfarlane's the Causes and Course of Organic Evolution*

This is an unusual book in several particulars, and notably in its wide scope, covering nearly the entire field of evolution on the earth, from "Ether and Energy in the evolution of matter" (Chapter I) to such topics as "Morals as a factor in organic evolution and their biological origin" (Chapter XXIII), "Religion as a factor in human evolution" (Chapters XXIV–XXVI), "Human organization in relation to environment" (Chapter XXIX), and "Probable future advances in human evolution" (Chapter XXX). Chapters I to VIII deal with the evolution of energy and of matter, inorganic and organic; Chapter IX with the idea and term (first elaborated and used by this author) of "Proenvironment"; Chapters XI–XIII with "The evolution of plants"; Chapters XIV–XVIII with "The evolution of animals"; and Chapters XIX–XXX with the evolution of man and questions closely connected therewith in the realms, not only of the physical, but of the intellectual, moral, religious, and social.

It is unusual to find a recent book dealing with the evolution of plant and animal forms, and having only 28 illustrations; and equally unusual to find a book of such pretensions as this one disregarding, or considering only briefly or incidentally, some of the working hypotheses that loom largest in contemporary research and in recent scientific periodicals and other publications—such hypotheses as, for example, the mutation theory and Mendelism, and the recent work in genetics, and eugenics. This is in harmony, however, with what appears to be the author's attitude toward some of this later work. For example, noting that Mendel and "nearly all of his followers have treated of naked eye appearances" to the neglect of cytological details, and referring to his own well known study of "unisexual and bisexual heredity" (1883), where "there is no *dominance* or *recessiveness* shown," he "considers that most of the cases of

* Macfarlane, John Muirhead. The causes and course of organic evolution. A study in bioenergetics. New York, The Macmillan Co., 1918. Pp. i–ix + 875. 28 figs., three colored plates, and one uncolored. $4.00.

'Mendelian inheritance' in plants and animals will probably be found to conform to such conditions, where they have been studied microscopically." This not only implies that dominance and recessiveness are the essence of Mendelism, as conceived by present day geneticists, but is also contrary to certain published results of Mendelian studies. It must be kept in mind that macroscopic characters (*e. g.*, color and coloration) are often mass effects of histological detail. In fact, the author states definitely his opinion "that most of the discussion on the possible acquisition of new characters, on the hereditary transmission of such, on dormant (*sic*) and recessive factors, have mainly been of value in stimulating research" (p. 150), and he considers that "varietal, specific, generic, and wider characters resolve themselves into the waxing or waning of definite substances, according as environal stimuli act on certain constituents of the cells."

The keynote of the volume, as stated in the preface, is that "*energy, continuity, evolution* may be said to constitute the triune basis of existence"; and, further on (pp. 170–171), that "Relative distribution and relative condensation of energy . . . are the important factors at the foundation of all organic as of all inorganic changes." In fact, the viewpoint throughout, as the subtitle would lead one to expect, is that of energy, rather than form, and the elaboration of this conception involves the use of an unfamiliar nomenclature, originating with the author, and running throughout the book. Thus, "in passing from the inorganic crystalloids and colloids to those composing organic bodies, the fundamental need of the case was the evolution and increasing activity of an energy that would as far excel electricity in its perfect quality as does the latter excel chemical affinity, and it again heat" (p. 77). Heat, light, chemical affinity and electricity, as phases of energy, have been unequal to the task of energizing "the inert ether particles that form the centers of the atomic and molecular structures" (p. 81) and the author formulates it as a working hypothesis, "that the transition from the inorganic colloid to the organic colloid body was gradually accompanied by the evolution of a new and more condensed phase or modification of energy, the '*biotic*'" (p. 33). Biotic

energy is "the basic energizer of organisms," and its "forerunner and anticipator" was "a redistribution of electric energy," which "distinguished chemists" consider "can be traced round each molecule" (p. 81). Biotic energy is "a more condensed, perfect, and powerful type of the all-pervading energy than even electric" (p. 26). The reviewer does not quite understand how one kind of energy can be more "perfect" than another. This adjective is frequently used throughout the book in comparing various kinds of energy (pp. 800–805). What is a "perfect" form of energy? How any of the lower forms of energy are converted into biotic energy is not known (p. 102).

Eight different kinds of energy are enumerated, viz., thermic, lumic, chemic, and electric, acting in non-living bodies; and biotic, cognitic, cogitic, and spiritic, acting only in living bodies. Biotic energy energizes protoplasm (*i. e.*, cytoplasm); cognitic energy energizes chromatin, it underlies the phenomena of irritability, awareness, response, and sense-perception. Cell division is "due to steady discharges . . . from the center of the nucleus or the nucleolus of cognitic energy," and conjugation "seems to be due to the establishment of unlike or differently charged amounts of cognitic energy," etc. In fertilization the "mutual" attraction of sperm and egg is not due to their molecules "as physical entities," but to definite discharges of chemic, electric, biotic, or other energies that transverse the particles," etc. Cogitic energy energizes the substance of the nerve ganglia (Nissl substance, neuratin). It is a "more perfect" (p. 801) form of energy than cognitic, and enables "organisms to form more complex and interlocked *impressions of a mental kind*" (p. 801). "There evidently exists a more complex form of energy than the biotic, cognitic, or even cogitic, and which we have termed the *spiritic*" (p. 801); and there is probably a specially complex substance in "the gray frontal matter of the brain, and which hypothetically we may call spiritin" (p. 804).

We have given considerable space to this unique conception and terminology because it is the unifying thought running throughout the book, and indicates the angle from which the entire question of evolution is conceived and discussed by the

author. Without implying any real analogy, one cannot help but recall here Harvey's statement in his epoch-making book, "The motion of the heart and blood in animals," viz: "Fernelius, and many others, suppose that there are aerial spirits and invisible substances . . . but Medical Schools admit three kinds of spirits: the natural spirits flowing through the veins, the vital spirits through the arteries, and the animal spirits through the nerves; . . . but we have found none of all these spirits by dissection, neither in the veins, nerves, arteries nor other parts of living animals." One is also reminded here of the primordial units of "mind-stuff," in which Clifford believed, though on evidence (so James tells us) that seemed quite worthless to Bain. It seems to the reviewer as though the author were reviving for the microcosm a conception analagous to that formerly held of the macrocosm, but long since abandoned in the light of the scientific investigation and interpretation of nature. The ancient polytheism, for example, postulated a spirit presiding over every natural process, and over every act of daily life—a god of the east wind, and of the west wind, of the sea and of the depths of the earth; a god of going out, and a god of returning home, a god of planting, and a god of harvest. So the book under review postulates a special kind of energy for the various kinds of functions, and each kind differs from all the other kinds in its "perfectness." A botanical reviewer may prudently refrain from a critical discussion of the purely physical question of kinds and qualities of energies, but it would be interesting and no doubt profitable, to hear what comments a physicist would make. An acceptance of the author's theory would demand a considerable readjustment of the mode of thought of contemporary experimental physiologists.

Another idea to which the author assigns much prominence and for which he coins a new term (as noted above), is "*proenvironment*" (Chapter IX, and *passim*). This is defined (p. 242) as "that great and ever-expanding law of organic life, by which varied environal stimuli are linked into a summated and unified response, that brings each organism into satisfied relation to the environment;" or again (p. 629), "the capacity of an or-

ganism for perceiving and then positively growing or moving toward an environment that is the most satisfying for it." The various tropisms, and the response of *Mimosa* leaves to shock are acts of proenvironment. "In all moral acts, as in simpler and more primitive actions and reactions amongst plants and animals, the fundamental outcome of moral response is a satisfied state" (p. 664). "Moral attitudes all represent proenvironal efforts by individuals" (p. 656). "Enterprise is varied and vigorous proenvironal planning that is being put into practice" (p. 641). "Sex fusion is a proenvironal act" (p. 789). "So the building of nests above ground, the excavation of nests below the surface, or the hollowing of trees into nests by ants and other insects; the gradual elaboration of complex log houses and dams by beavers; the planning and erection of a lake dwelling by medieval man are all proenvironal acts," etc. (p. 790). "Mankind has proenvironed the law, "Thou shalt love thy neighbor as thyself" (p. 791). The idea of proenvironment, or something closely akin to it, was proposed by Cockayne and Foweraker in their paper on "The principal plant associations in the immediate vicinity of Canterbury College Mountain Biological Station" (Trans. New Zealand Inst. 48: 166. 1916). The term there proposed was *Epharmonic variation*, which was defined as "a change in its form of physiological behavior beneficial to an organism, evoked by the operation of some environmental stimulus." For the intellectual realm the idea is also stated by James in "The Will to Believe," where he says (p. 76): ". . . of two conceptions equally fit to satisfy the logical demand, that one which awakens the active impulses, or satisfies other aesthetic demands better than the other, will be accounted the more rational conception, and will deservedly prevail." The conception, however, appears to have been nowhere so thoroughly elaborated as by the author under review.

In Chapter VIII the author postulates the law of "Pentamorphogeny," that is, that there are five factors or cooperative agents in organic evolution, namely, heredity, environment, proenvironment, selection, and reproduction (p. 204). This is somewhat in contrast to Osborn's law of "Tetraplasy," the

"four inseparable factors of evolution" (heredity, ontogeny, environment, and selection). Macfarlane rejects ontogeny as a cause or factor in evolution.

In accepting the hypothesis "that living and non-living bodies are alike irritable" (p. 44), no reference is made to Bose's full development of that idea in his Response in the Living and Non-living, and other writings.

On page 81 "inert ether particles" are referred to as forming "the centers of the atomic and molecular structures." No reference is here made to the electron theory of atomic structure, which regards the atom as, in figurative sense, a miniature "solar system," with negative electrons moving in orbits around a nucleus of positive and negative electrons—chiefly positive. This hypothesis, based upon studies in radioactivity and related investigations, has been the one in most general favor with physicists for a decade or so. Attention may also be called here to a present tendency of some physicists to question the older conception of a universal elastic ether, in light of the theory of relativity, which originated in the famous *experimentum crucis* of Michelson and Morley (1887) to obtain evidence of an ether drift." In fact, a physicist friend has assured the reviewer that the expression "inert ether particles" does not convey any meaning to a physicist.

Adhering to the energy point of view, and the point of view of a granular or atomic ether, protoplasm is defined (p. 86) as "a definitely correlated rotatory motion of variously energized (or linked) and highly complex groups of ether particles of colloid nature, in which the specific rates of motion between the groups are an expression of biotic energy." This would seem to define protoplasm as a mode of motion rather than as a substance. In harmony with this conception, life is defined (p. 97), as "Relatively similar complexity and synchronism of motion of quinary, hexary, and heptary compounds, that represent similar complex definiteness of structure and similar lines of flow of biotic energy."

The different tropisms shown by living organisms depend each upon a special class or kind of plastids or energids which "show a

special sensitivity and polarity to environal stimuli (p. 121); these plastids evolved in the probable order of leucoplastids (chemoenergids), helioplasts (chromoplasts and chloroplasts) or photoenergids, geoplasts (geoenergids), thigmoplasts (mechano-energids), and parohelioplasts, which "are only known in their energizing results, not as yet as definite structures. Thus for every class of physiological function there is postulated by the author, not only a particular kind of energy, but also a particular structure. Some of these structures are known only by inference from a given function. This granular philosophy is extended to include the notion that there is "a large series of bodies common to all plants . . . which can at any time be gradually reproduced by the joint action on, and reaction of protoplasm and its related ferments under the more fundamental action of appropriate environmental stimuli." These bodies may at times be reduced to ultra-microscopic bodies (p. 150). This conception would appear to be a form of, or analogous to, pangenesis. Its acceptance, according to the author, leads logically to a rejection of the concept of "acquired characters," and therefore the troublesome problem of the inheritance (or otherwise) of acquired characters vanishes.

In the discussion of heredity, on pages 175–179, no reference is made to much modern work—Spencer's definition, for example, being quoted, but no reference made to Johannsen's fruitful definition and studies. Johannsen's definition, "the appearance, in successive generations, of the same genotypical constitution of the protoplasm," is suggested by the author's definition: "the like continuity of molecular structure in relation to like outgoing and incoming currents of energy, so long as a body is exposed to the same environment, or to an environment that, within definite limits, fails to alter its average constitution" (p. 179). This definition involves the conception that variation, or disturbance of heredity (p. 178) is "due to changed environal condition," which is the prevailing conception of geneticists as to the cause of variation. On page 187 both heredity and variation are defined in terms of energy.

The theory is maintained (p. 301, and elsewhere) that "the

simpler animals evolved as offshoots from colorless bacterial lines of plant organization. A review of the chapters on animal evolution is not here attempted.

The statement that, when spores mature, "they throw off and break down so much chromatin material" (p. 335), is apt to mislead, if indeed it is not incorrect as referring to the reduction division resulting in the haploid number of chromosomes. The phenomenon of alternation of generations is erroneously limited to "classes of plants higher than the algae" (p. 336), Hoyt's work with *Dictyota*, Harper's with Ascomycetes, and Blackman's with rusts, for example, being overlooked. In the genealogical tree (facing page 356) the now generally recognized group, Cycadofilices, does not appear to be mentioned. The hypothesis that monocotyledons and dicotyledons "all sprang from the great Cordaital stock" (p. 367) is at variance with a mass of evidence and opinion to the effect that the Cordaitales are not in the ancestral line of the angiosperms at all, but only of the gymnosperms.

Pages 598 to 850 of the book are devoted to psychological, archaeological, anthropological, religious, and sociological questions of which only brief mention can be made in a botanical magazine. It is interesting to note that the author postulates morality for the lower animals (p. 660). "Why," he asks, "should the maternal care of the bird . . . be denied the praise of being moral?" That morals "do not originate with man . . . is clearly shown by the many moral acts of bees, beavers, crows, ants, and apes." In Chapter XXVII on "The competitive system amongst the lower animals and with man," the social sympathies of the author seem to be indicated by the dark picture which he draws in the following quotation (p. 764): "The papers, the press, the universities and the churches are nearly all comfortably subsidized in diverse and skillful ways, *in order that* they may support 'the system.'" (The italics are the reviewer's.) This is not the place to discuss such statements, nor perhaps even to refer to them, except that they tend to inspire confidence, or otherwise (according to the reader's own convictions), in the author's judicial attitude of mind, and the logicalness of

his conclusions with reference to purely botanical or zoological questions.

The book is a very thoughtful, sincere, and scholarly treatment of the entire range of evolutionary thought.

C. Stuart Gager

The Swiss League for the Protection of Nature *

A delightful book has been published in England and translated into French, giving descriptions and illustrations of the Alpine Flora of Switzerland. The pictures include snowy peaks and evergreen slopes and are in the daintiest pastel colors, tinged with the blues and purples of the distant views, and in the foreground beautiful with charming groups of alpine flowers, filling the slopes and meadows, clinging in crevices of steep cliffs and rocks and filling the spaces among the stones of the dangerous mountain trails. Here will be found in April, the hepatica and the crocus, or the primroses with the Matterhorn in the distance and the gentians at the foot of the glaciers; in June the anemones and spikes of purple orchids, wild geraniums and globe flowers; the edelweiss and Alpine rose with marguerites, hawkweed, and rampion filling the alpine meadows in July; lovely ravines, fringed with evergreens, with a gorgeous carpet of rainbow colors in the foreground melting off into the pale blues and snowy peaks of the dim distance.

One of the chapters is devoted to the work which has been accomplished in the last twenty years by the Swiss League for the Protection of Nature, of which M. Henry Correvon is the president. The League has been instrumental in setting aside several alpine gardens as sanctuaries for animals and plants and a most interesting account may be found of its experiences with the tourists on whose favor and numbers the prosperity of Switzerland so much depends. Instructions are given to the guides to prevent depredations, but sometimes even they have to look the other way and ignore the peccadilloes of rapacious tourists ("*touris-*

* Sur L'Alpe Fleurie, Promenades Poetiques et Philosophiques dans les Alpes par G. Flemwell, adapté de L'anglais par L. Marret et L. Capitaine, Avec 63 illustrations dont 20 planches hors texte en couleurs. Soc. D'Edition des Sciences Naturelles. L. Marret et Cie, Paris. May, 1914.